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Title:

“Combustion Stability Verification for the Thrust Chamber Assembly of J-2X Developmental Engines 10001, 10002, and 10003”

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Abstract:

The J-2X engine, a liquid oxygen/liquid hydrogen propellant rocket engine available for future use on the upper stage of the Space Launch System vehicle, has completed testing of three developmental engines at NASA Stennis Space Center. Twenty-one tests of engine E10001 were conducted from June 2011 through September 2012, thirteen tests of the engine E10002 were conducted from February 2013 through September 2013, and twelve tests of engine E10003 were conducted from November 2013 to April 2014. Verification of combustion stability of the thrust chamber assembly was conducted by perturbing each of the three developmental engines. The primary mechanism for combustion stability verification was examining the response caused by an artificial perturbation (bomb) in the main combustion chamber, i.e., dynamic combustion stability rating. No dynamic instabilities were observed in the TCA, although a few conditions were not bombed. Additional requirements, included to guard against spontaneous instability or rough combustion, were also investigated. Under certain conditions, discrete responses were observed in the dynamic pressure data. The discrete responses were of low amplitude and posed minimal risk to safe engine operability. Rough combustion analyses showed that all three engines met requirements for broad-banded frequency oscillations. Start and shutdown transient chug oscillations were also examined to assess the overall stability characteristics, with no major issues observed.

1. Casiano, M.J., Kenny, R.J., Barnett, G.L., Hulka, J.R., Hinerman, T.D., Dodd, F.E., Martin III, T.N., Hulka, J.R., "Status on the Verification of Combustion Stability for the J-2X engine Thrust Chamber Assembly," 60th JANNAF Propulsion Meeting and Joint Meeting of the 9th Modeling & Simulation Subcommittee (MSS) / 7th Liquid Propulsion Subcommittee (LPS) / and 6th Spacecraft Propulsion Subcommittee (SPS) , Colorado Springs, CO, April 29-May 3, 2013.
2. Kenny, R.J., Hulka, J.R., Casiano, M.J., Fischbach, S.R., "Signal Processing Methods for Liquid Rocket Engine Combustion Spontaneous Stability and Rough Combustion Assessments," 60th JANNAF Propulsion Meeting and Joint Meeting of the 9th Modeling & Simulation Subcommittee (MSS) / 7th Liquid Propulsion Subcommittee (LPS) / and 6th Spacecraft Propulsion Subcommittee (SPS) , Colorado Springs, CO, April 29-May 3, 2013.
3. Kenny, R.J., Lee, E.N., Hulka, J.R., Casiano, M.J., "Signal Processing Methods for Liquid Rocket Engine Combustion Stability Assessments," Joint Meeting of the 8th Modeling and Simulation Subcommittee (MSS) / 6th Liquid Propulsion Subcommittee (LPS) / 5th Spacecraft Joint Subcommittee (SPS), Huntsville, AL, December 5-9, 2011.